Microflown Technologies
Charting sound fields

Application note: Scan and Listen

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Figure 1: On the left a pu probe which can be connected with a cable to the Scan and Listen device on the right. With a set of headphones both the u and p signal can be listened to instantly.

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1. What is sound?

The two quantities in sound are sound pressure, called p and the acoustic particle velocity, called u. When p and u are multiplied you get the sound intensity.

This can be compared with electrics where
Power [Watts] = Voltage [Volt] * Current [Ampere]. The voltage in electrics is the same as sound pressure in acoustics and the current is the same as acoustic particle velocity.

The human ear is only sensitive to sound pressure.

2. Sensitivity

A normal microphone which measures the sound pressure is equally sensitive in every direction.

A Microflown which measures the acoustic particle velocity is sensitive in a figure of eight configuration. This means it is most sensitive at 90 and 270 degrees and insensitive at 0 and 180 degrees.

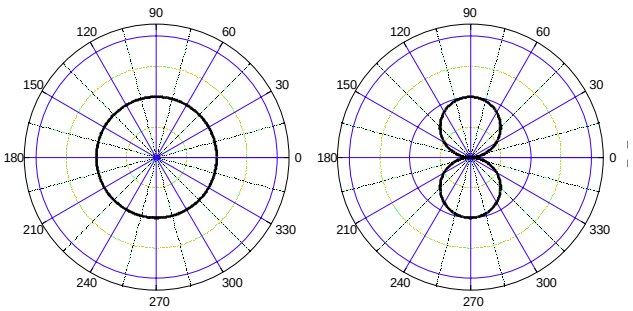

Figure 2: Sensitivity of a microphone (left) and of a Microflown (right) .

Therefore the Microflown is direction sensitive, or in other words the Microflown can hear where the sound is coming from.

If the sound comes from ‘above’ (between ~179 and 1 deg.) the Microflown gives a positive output signal, when the sound comes from ‘below’ (between ~181 and 359 deg.) the output is negative.

3. Scanner Listener

With the Scanner Listener the sound pressure and acoustic particle velocity can be measured and heard instantly. Figure 1 shows the Scan and Listen device.

The advantage of measuring u is the fact that close to a hard surface all reflections and background noise are faded out. So the object itself can be heard without the disturbances.

This eliminates the need for an anechoic room which is required for sound pressure measurements.

4. The Gong experiment

To show what difference it makes listening to p or u with the Scanner Listener an experiment was done. The experiment is named the Gong experiment. The test setup can be seen in Figure 3.

Figure 3: Test setup of the Gong experiment, the hard plate on the left and the gong on the right. The pu probes are inside the red circles.

First of all p and u were measured about 5 mm from the surface of the gong. As you can hear they sound about the same.

Next p and u are measured in front of a hard plate opposite of the gong. When listening to the pressure signal the gong can be heard very well, but when listening to the particle velocity signal almost nothing can be heard. This is because background noise is reduced considerably when measuring in front of a hard surface.

Now the first measurement is repeated but now with background noise. The pressure and particle velocity are measured again.

The pressure signal is disturbed noticeably by the background noise, while the background noise is almost not heard when listening to the particle velocity signal. This proofs once again that the background noise is reduced allot when listening to the particle velocity.

Secondly it proofs that, when you listen to the particle velocity signal, the sound the gong produces can be heard clearly without the background noise.

For the last measurement p and u are measured in front of the hard plate with background noise. When listening to the pressure signal the background noise and the gong can both be heard very well. But when listening to the particle velocity signal both background noise as gong sound are reduced considerably.

5. Conclusions

When measuring close to a hard surface background noises and reflections are reduced considerably.

Secondly an object which is making noise can be heard in a loud environment, because background noise is reduced to a minimum close to the surface of the object. This eliminates the need for an anechoic room.